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09/714,410	11/14/2000	Stewart K. Griffiths	SD-8263	5050
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Timothy Evans Sandia National Laboratories 7011 East Avenue Livermore, CA 94550				
EXAMINER MUTSCHLER, BRIAN L				
ART UNIT		PAPER NUMBER		
1753				

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .	Applicant(s)	
09/714,410	GRIFFITHS ET AL.	
Examin r	Art Unit	
Brian L. Mutschler	1753	

-- Th MAILING DATE of this communication appears on the cover sh et with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_\_.
- 2a) ☐ This action is FINAL.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) 31-41 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 14 November 2000 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                  | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)         | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other:  |

**DETAILED ACTION**

***Election/Restrictions***

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
  - I. Claims 1-30, drawn to a method for producing a thin sample band in a microchannel system, classified in class 204, subclass 453.
  - II. Claims 31-41, drawn to an apparatus for analyzing or processing a sample, classified in class 204, subclass 601.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions of Group I and Group II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP § 806.05(e)). In this case the apparatus can be to practice other processes, such as mixing multiple components for reacting.
3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.
4. During a telephone conversation with Mr. Timothy Evans on September 23, 2003, a provisional election was made without traverse to prosecute the invention of Group I, claims 1-30. Affirmation of this election must be made by applicant in replying to this Office action. Claims 31-41 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

### ***Drawings***

6. Figures 2A-2H, 3A-3H, 4A-4H, 12, 13 and 14 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

7. The drawings are objected to because the label "FIG. 1H" on the third page of drawings should be changed to --FIG. 3H--. In Figure 5H, the reference character "**207**" should be changed to --**207'**-- to correctly identify the initial sample band as opposed to the lobes, as shown in Figure 5C. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

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### ***Specification***

8. The disclosure is objected to because of the following informalities:

- a. On page 4 at line 2, please change "channels **112**" to --channels **112 - 115**--.

Appropriate correction is required.

### ***Claim Objections***

9. Claims 1, 9, 11, 12, 26 and 30 are objected to because of the following informalities:

- a. In claim 1 at lines 17 and 18, please change "said band" to --said sample band-- to maintain consistency throughout the claims.
- b. In claim 9 at line 1, please insert --electric fields-- or --transport electric fields-- (see below) after "applying".
- c. In claim 10 at line 1, please insert --said sample band-- after "inserting".
- d. In claim 11 at line 1, please insert --said sample band-- after "inserting".
- e. In claim 26 at lines 4-5, please delete the semicolon ";" and join the two phrases. The two phrases are part of a single step.
- f. In claim 30 at line 2, please change "Applying" to --applying--.
- g. In claim 30 at line 3, please insert a comma "," after "second".

Appropriate correction is required.

### ***Claim Rejections - 35 USC § 112***

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. Claims 1-30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites the limitation "said channel first ends" in line 5. There is insufficient antecedent basis for "said channel" (singular) in the claim. It is suggested that the phrase be changed to --said first ends of said channels--. The same applies to dependent claims 2-12 and 14-27.

Claim 1 recites the limitations "said first and second channels" in line 6 and "said third and fourth channels" in line 7. There is insufficient antecedent basis for these limitations in the claim. Although at least four channels have been introduced, specific channels, such as those identified by "first" and "second", have not been identified. It is suggested that the phrases be changed to --first and second channels-- and --third and fourth channels--, respectively, by deleting the word "said" in each phrase. The same applies to dependent claims 2-12 and 14-27.

Claim 8 recites the limitation "said channel second ends" in line 1. There is insufficient antecedent basis for "said channel" (singular) in the claim. It is suggested that the phrase be changed to --said second ends of said channels--. The same applies to dependent claims 26 and 27.

Claim 10 is indefinite because the relationship between the sample material and the band of sample material in claim 1 is unclear. In claim 1, the method comprises the step of inserting a band of sample material into a region near the first end of the first channel; in claim 10, the third channel has a supply reservoir containing a quantity of

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the sample material. Therefore, claim 10 appears to have two different sample materials. It is suggested that claim 10 be amended to clarify that the sample material in the supply reservoir supplied the sample material that is inserted into the first end of the first channel to clarify the purpose of the supply reservoir and the relationship between the sample material band and the sample material in the reservoir.

Claims 11 and 12 are indefinite because they introduce additional electric fields not clearly distinguished from the electric fields applied in claim 1. It is not apparent whether a total of two or three electric fields are used. It is suggested that identifiers be added to clearly identify the electric fields as three separate electric fields. An example would be to use "applying transport electric fields" in claim 1 and "applying first [or second] inserting electric fields" in claims 11 and 12, so that the electric fields applied in claim 1 are clearly distinguished from the electric fields recited in claims 11 and 12.

Claim 13 recites the limitation "said channel first ends" in line 6. There is insufficient antecedent basis for "said channel" (singular) in the claim. It is suggested that the phrase be changed to --said first ends of said channels--.

Claim 13 recites the limitations "said first and second channels" in lines 6-7 and "said third and fourth channels" in lines 7-8. There is insufficient antecedent basis for these limitations in the claim. It is suggested that the phrases be changed to --first and second channels-- and --third and fourth channels--, respectively.

Claim 13 recites the limitation "said sample material" in lines 19, 22 and 25. There is insufficient antecedent basis for this limitation in the claim. In line 11, the sample is introduced as "a sample", not "a sample material". It is suggested that "said

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sample material" (lines 19, 22 and 25) be changed to --said sample-- or that "a sample" (line 11) be changed to --a sample material--.

Claim 13 recites the limitation "said sample reservoir" in line 19. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --said reservoir means--.

Claim 14 is indefinite because there is not a clear relationship between the step recited in claim 14 and the steps recited in claim 1. In claim 1 at lines 14-19, electric fields were applied to transport the sample band from the first end of the first channel towards the second, third and fourth channels such that portions of the sample band enter the third and fourth channels. Claim 14 recites applying electric fields to transport the sample band from a region proximal to the first end of the second channel toward the first end of the first channel, and portions of the sample band enter the third and fourth channels. How and when did the sample band reach a position proximal to the first end of the second channel? Since a final destination of the sample band was never recited in claim 1, it is suggested that claim 1 be amended to identify that the sample band is positioned in a region proximal to said second channel first end, and changing the limitation appearing in line 3 of claim 14 from "a region proximal to said second channel first end" to --said region proximal to said second channel first end--. The same applies to dependent claims 15-17.

Claim 15 recites the limitation "said electric fields along said first and second channels" in line 2. This limitation is indefinite because it is not clear whether the limitation is referring to the electric fields applied in claim 1 or the electric fields applied



in claim 14. Both sets of electric fields are applied over the first and second channels; therefore, it is not clear which step reverses the current. The same applies to dependent claims 16 and 17.

Claims 16 and 17 both recite the limitation "wherein said sample band is initially inserted proximal to said first channel first end" in lines 1-2 of each claim. Claim 1 recites a step wherein the sample band is inserted in a region near the first channel first end. The limitation appearing in claim 16 and 17 appears to suggest that the sample band can be inserted an area other than the region near the first channel first end or that multiple insertions can occur. This language is unclear because it either introduces multiple insertions or implies alternative insertion points not suggested by the insertion step of claim 1.

Claim 28 recites the limitation "said channel first ends" in line 5. There is insufficient antecedent basis for "said channel" (singular) in the claim. It is suggested that the phrase be changed to --said first ends of said channels--.

Claim 28 recites the limitations "said first and second channels" in line 6 and "said third and fourth channels" in line 7. There is insufficient antecedent basis for these limitations in the claim. It is suggested that the phrases be changed to --first and second channels-- and --third and fourth channels--, respectively.

Claim 28 recites the limitation "said four channels" in line 31. There is insufficient antecedent basis for this limitation in the claim. The limitation "at least four transport channels" was introduced in lines 3-4. Since the actual number of channels

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is not explicitly recited, it is suggested that the phrase be changed to --each of said channels--.

Claim 29 recites the limitation "said channel first ends" in line 6. There is insufficient antecedent basis for "said channel" (singular) in the claim. It is suggested that the phrase be changed to --said first ends of said channels--. The same applies to dependent claim 30.

Claim 29 recites the limitations "said first and second channels" in lines 6-7 and "said third and fourth channels" in lines 7-8. There is insufficient antecedent basis for these limitations in the claim. It is suggested that the phrases be changed to --first and second channels-- and --third and fourth channels--, respectively. The same applies to dependent claim 30.

Claim 29 recites the limitation "said sample material" in lines 19 and 21. There is insufficient antecedent basis for this limitation in the claim. In line 11, the sample is introduced as "a sample", not "a sample material". It is suggested that "said sample material" (lines 19 and 21) be changed to --said sample-- or that "a sample" (line 11) be changed to --a sample material--. The same applies to dependent claim 30.

Claim 29 recites the limitation "said sample reservoir" in claim 19. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --said reservoir means--. The same applies to dependent claim 30.

Claim 29 recites the limitation "said four channels" in line 23. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --each of said channels--. The same applies to dependent claim 30.

Claim 30 recites the limitation "said four channels" in line 2. There is insufficient antecedent basis for this limitation in the claim. It is suggested that the phrase be changed to --each of said channels--.

***Claim Rejections - 35 USC § 102***

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

13. Claims 1-10, 13, 14, 18-21, 24, 26 and 27 are rejected under 35 U.S.C. 102(b) as being anticipated by Ramsey (U.S. Pat. No. 5,858,195).

Regarding claim 1, Ramsey provides a method for producing a sample band in a microchannel system comprising the following steps:

(a) Providing a junction formed at an intersection of at least four transport channels lying in a common plane. As shown in Figure 31B, the junction

**40** is formed at the intersection of four channels, wherein each pair of channels is co-linear and the pairs of channels are arranged perpendicular to one another (fig. 31B).

- (b) Filling each of the channels and junction with a transport medium (col. 7, lines 12-57; col. 9, lines 35-40).
- (c) Inserting a band of a sample material into a region near said first channel end. Figure 31A shows the sample being inserted into the channels connecting reservoir **16** (3<sup>rd</sup> channel) to reservoir **18** (4<sup>th</sup> channel) (fig. 31A). The sample would be in a region near any one of the first ends of the channels.
- (d) Applying electric fields along each of the channels to induce transport of the sample. As seen in Figure 31B, electric fields are applied to drive the sample from the direction of reservoirs **12** and **14** (1<sup>st</sup> channel) in the direction of reservoirs **16**, **18** and **20** (3<sup>rd</sup>, 4<sup>th</sup> and 2<sup>nd</sup> channels, respectively) (fig. 31B; col. 33, lines 13-38).

Regarding claim 2, the application of the electric fields is such that the electric fields to each of the channels are altered to inject the sample into the 2<sup>nd</sup> channel (figs. 31A and 31B).

Regarding claim 3, the transport medium is a fluid (col. 9, lines 35-40).

Regarding claims 4-7, the method is used to provide both electroosmotic flow (injection) and electrophoretic flow (separation) (col. 7, lines 12-57; col. 9, lines 35-40).

Regarding claim 8, each channel is connected to a reservoir, and each reservoir has an electrode to apply a controlled voltage (fig. 1).

Regarding claim 9, the step of applying the transport electric fields is performed using the same magnitude electric fields across the 3<sup>rd</sup> and 4<sup>th</sup> channel (reservoirs **16** and **18**) (fig. 32).

Regarding claim 10, the 3<sup>rd</sup> channel comprises a reservoir **16** which is a supply reservoir for supplying analyte, and the 4<sup>th</sup> channel comprises a waste reservoir **18** (col. 33, lines 20-25).

Regarding claims 13, the method of Ramsey comprises the steps of:

- (a) Providing a junction formed at an intersection of at least four transport channels lying in a common plane. As shown in Figure 31B, the junction **40** is formed at the intersection of four channels, wherein each pair of channels is co-linear and the pairs of channels are arranged perpendicular to one another (fig. 31B).
- (b) Filling each of the channels and junction with a transport medium (col. 7, lines 12-57; col. 9, lines 35-40).
- (c) Providing a supply reservoir **16** on the 3<sup>rd</sup> channel (col. 33, lines 20-25).
- (d) Providing a power supply and electrode means to each of the reservoirs (fig. 1).
- (e) Applying first electric fields along the 3<sup>rd</sup> and 4<sup>th</sup> channels to transport the sample into the junction (fig. 31A). Due to the properties of electric fields, the sample would also enter into the 1<sup>st</sup> and 2<sup>nd</sup> channels as well.

- (f) Applying second electric fields along the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> channels and out of the junction yielding a sample band in the first end of the 1<sup>st</sup> channel (fig. 31B). (The assignment of the labels 1<sup>st</sup> and 2<sup>nd</sup> channels is switched in comparison to the description of claim 1 above. The name of the channel is arbitrary as long as the same nomenclature is used consistently through each separate method.)

Regarding claim 14, electric fields are applied along the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> channels and transported from a region near the 2<sup>nd</sup> channel first end towards the 1<sup>st</sup> channel (figs. 31A and 31B).

Regarding claim 18, the 3<sup>rd</sup> and 4<sup>th</sup> channels (corresponding to reservoirs **16** and **18**) are co-linear along a secondary axis, wherein the secondary axis is perpendicular to the primary axis (fig. 1).

Regarding claim 19, each of the channels has a width (fig. 1; col. 9, lines 1-6).

Regarding claim 20, the widths of the channels are substantially the same (col. 9, lines 60-62).

Regarding claim 21, the junction of the channels is square and the width of the junction is equal to the width of the channels (fig. 3).

Regarding claim 24, the width of at least one channel is less than about 1000 microns (col. 9, lines 1-6).

Regarding claims 26 and 27, the electric fields are controlled by applying an electric potential to each of the electrodes and by varying the potential magnitude and polarity (fig. 32).

Since Ramsey teaches all of the limitations recited in the instant claims, the reference is deemed to be anticipatory.

14. Claims 1-7, 9, 18-21 and 24 are rejected under 35 U.S.C. 102(a) as being anticipated by Ermakov et al. ("Computer Simulations of Electrokinetic Injection Techniques in Microfluidic Devices," *Anal. Chem.* **2000**, 72, pp. 3512-3517).

Regarding claim 1, Ermakov et al. provide a method for producing a sample band in a microchannel system comprising the following steps:

- (a) Providing a junction formed at an intersection of at least four transport channels lying in a common plane. As shown in Figure 1, the junction is formed at the intersection of four channels, wherein each pair of channels is co-linear and the pairs of channels are arranged perpendicular to one another (fig. 1).
- (b) Filling each of the channels and junction with a transport medium (p. 3512).
- (c) Inserting a band of a sample material into a region near said first channel end. Figure 1 shows the sample being inserted into the channels **3** and **1** (fig. 1). The sample would be in a region near any one of the first ends of the channels.
- (d) Applying electric fields along each of the channels to induce transport of the sample. As seen in Figure 1, electric fields are applied to each of the channels to drive the sample from channel **2** into channel **4**, while pulling

portions of the sample into channels **1** and **3** (fig. 1; p. 3512). In Figure 1, channel **2** corresponds to the 1<sup>st</sup> channel, channel **4** corresponds to the 2<sup>nd</sup> channel, channel **3** corresponds to the 3<sup>rd</sup> channel, and channel **1** corresponds to the 4<sup>th</sup> channel.

Regarding claim 2, the application of the electric fields is such that the electric fields to each of the channels are altered to inject the sample into the 2<sup>nd</sup> channel (fig. 1).

Regarding claim 3, the transport medium is a fluid (p. 3512).

Regarding claims 4-7, the method is used to provide both electroosmotic flow (injection) and electrophoretic flow (separation) (p. 3512).

Regarding claim 9, the step of applying electric fields is performed such that the electric fields along the 3<sup>rd</sup> and 4<sup>th</sup> channels are the same, which would result in transport of equal portions of the sample into the channels (fig. 3).

Regarding claim 18, the 3<sup>rd</sup> and 4<sup>th</sup> channels are co-linear along a secondary axis, wherein the secondary axis is perpendicular to the primary axis (fig. 1).

Regarding claim 19, each channel has a width (fig. 1).

Regarding claim 20, the widths of the channels are the same (p. 3513).

Regarding claim 21, the junction is square and each side of the junction is equal to the channel width (fig. 1).

Regarding claim 24, the channel width is less than about 1000 microns (p. 3513).

Since Ermakov et al. teach all of the limitations recited in the instant invention, the reference is deemed to be anticipatory.



***Claim Rejections - 35 USC § 103***

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. Claims 8, 10, 13 and 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermakov et al. ("Computer Simulations of Electrokinetic Injection Techniques in Microfluidic Devices," *Anal. Chem.* **2000**, 72, pp. 3512-3517) in view of Soane et al. (U.S. Pat. No. 5,750,015).

Ermakov et al. teach a method having the limitations recited in claims 1-7, 9, 18-21 and 24 of the instant invention, as explained above in section 14.

Regarding claim 13, Ermakov et al. teach the following steps:

- (a) Providing a junction formed at an intersection of at least four transport channels lying in a common plane. As shown in Figure 1, the junction is formed at the intersection of four channels, wherein each pair of channels is co-linear and the pairs of channels are arranged perpendicular to one another (fig. 1).
- (b) Providing each of the channels and junction with a transport medium (p. 3512).
- (c) Providing a power supply (fig. 3; p. 3512).

- (d) Providing means for controlling the power supply such that electric fields may be applied along each of the channels (fig. 3; p. 3512).
- (e) Applying first electric fields along the 3<sup>rd</sup> and 4<sup>th</sup> channels (channels **3** and **1**) to fill regions of the first ends of the 1<sup>st</sup> and 2<sup>nd</sup> channels (fig. 1).
- (f) Applying second electric fields along each of the channels to induce transport of the sample. As seen in Figure 1, electric fields are applied to each of the channels to drive the sample from channel **2** into channel **4**, while pulling portions of the sample into channels **1** and **3** (fig. 1; p. 3512). In Figure 1, channel **2** corresponds to the 1<sup>st</sup> channel, channel **4** corresponds to the 2<sup>nd</sup> channel, channel **3** corresponds to the 3<sup>rd</sup> channel, and channel **1** corresponds to the 4<sup>th</sup> channel.

Regarding claim 26 and 27, the electric fields are controlled by applying an electric potential to each of the channels and varying the magnitude and polarity of the potentials (fig. 3).

The method of Ermakov et al. differs from the instant invention because Ermakov et al. do not disclose the following:

- a. The second ends of the channels are connected to reservoirs, and each reservoir contains an electrode connected to a power supply, as recited in claim 8.
- b. The third and fourth channels are in communication with reservoirs, as recited in claim 10.
- c. The third channel has a reservoir, as recited in claim 13.

- d. The channels have electrode means, as recited in claim 13.
- e. A portion of the system comprises a separation matrix disposed therein, as recited in claim 25.

Regarding claims 8, 10 and 13, Soane et al. disclose a method for moving molecules using a plurality of electric fields and a device comprising a plurality of channels; wherein each channel is connected to a reservoir (fig. 2). In addition, each reservoir is connected to an electrode for controlling the electric field (fig. 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ermakov et al. to use a plurality of reservoirs and electrodes connected to each reservoir as taught by Soane et al. because using a plurality of reservoirs allows more reagents and analytes to be stored to perform more separations or reactions, and using an electrode at each reservoir allows the electric fields to be controlled in each channel.

Regarding claim 25, Soane et al. disclose the use of either buffered solutions or gels to perform separations (col. 1, lines 49-65). Gels allow the separation of molecules by size (col. 1, lines 49-65).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ermakov et al. to use a gel (separation matrix) as taught by Soane et al. because the use of a gel allows the molecules to be separated by size.

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17. Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ramsey (U.S. Pat. No. 5,858,195) in view of Parce et al. (U.S. Pat. No. 6,080,295).

Ramsey teaches a method having the limitations recited in claims 1-10, 13, 14, 18-21, 24, 26 and 27 of the instant invention, as explained above in section 13.

The method of Ramsey differs from the instant invention because Ramsey does not disclose the use of a junction having a height perpendicular to the primary axis that is greater than the smallest channel width, as recited in claim 22, or a width of the junction larger than the smallest channel width, as recited in claim 23.

Parce et al. disclose a method for separating molecules using a microfluidic device where the width of the junction is greater than the smallest channel width (figs. 6A-6C). The junction has a square shape rotated 45° with respect to the axis of the channels and has a dimension greater than the width of the channels so that the sample is funneled into desired channel (col. 18, lines 13-30).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ramsey to use a junction having the geometry taught by Parce et al. because the junction of Parce et al. funnels the sample into the desired channel, which concentrates the sample.

18. Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ermakov et al. ("Computer Simulations of Electrokinetic Injection Techniques in Microfluidic Devices," *Anal. Chem.* **2000**, 72, pp. 3512-3517) in view of Parce et al. (U.S. Pat. No. 6,080,295).

Ermakov et al. teach a method having the limitations recited in claims 1-7, 9, 18-21 and 24 of the instant invention, as explained above in section 14.

The method of Ermakov et al. differs from the instant invention because Ermakov et al. does not disclose the use of a junction having a height perpendicular to the primary axis that is greater than the smallest channel width, as recited in claim 22, or a width of the junction larger than the smallest channel width, as recited in claim 23.

Parce et al. disclose a method for separating molecules using a microfluidic device where the width of the junction is greater than the smallest channel width (figs. 6A-6C). The junction has a square shape rotated 45° with respect to the axis of the channels and has a dimension greater than the width of the channels so that the sample is funneled into desired channel (col. 18, lines 13-30).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ermakov et al. to use a junction having the geometry taught by Parce et al. because the junction of Parce et al. funnels the sample into the desired channel, which concentrates the sample.

19. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ramsey (U.S. Pat. No. 5,858,195) in view of Soane et al. (U.S. Pat. No. 5,750,015).

Ramsey teaches a method having the limitations recited in claims 1-10, 13, 14, 18-21, 24, 26 and 27 of the instant invention, as explained above in section 13.

The method of Ramsey differs from the instant invention because Ramsey does not disclose the use of a separation matrix in a portion of the system, as recited in claim 25.

Regarding claim 25, Soane et al. disclose the use of either buffered solutions or gels to perform separations (col. 1, lines 49-65). Gels allow the separation of molecules by size (col. 1, lines 49-65).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ramsey to use a gel (separation matrix) as taught by Soane et al. because the use of a gel allows the molecules to be separated by size.

***Allowable Subject Matter***

20. Claims 11, 12, 15-17 and 28-30 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.

21. Claims 11, 12, 15-17 and 28-30 are distinguished over the prior art of record because the prior art of record does not teach the use of more than two applied electric fields for producing a thin sample band. Both Ermakov et al. and Ramsey teach the use of two applied electric fields, wherein the second electric field results in the passage of the sample band into the separation channel. The instant invention uses at least one additional electric field to transport the sample material across the junction before a final electric field transports the sample band into the separation channel.

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22. Regarding claims 28 and 29, in US 2002/0008028 A1, Jacobson et al. disclose a method producing the same result as the instant invention, but the method requires two applied electric fields and an additional junction (see Figures 2A, 2B, 3A and 3B). The instant invention eliminates the need for the additional junction by using a thirds electric field. Therefore, the instant invention provides a method that can achieve the same result eliminating the need for a more complex device with more electrodes and channels.

### ***Conclusion***

23. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Pat. No. 5,429,728, issued to Gordon, teaches a method for controlling the band thickness in a single channel. U.S. Pat. No. 6,375,817, issued to Taylor et al., teaches another method using three electric fields in a different order. JP 05-072178 teaches a method for producing a thin sample band by compressing the band against a membrane.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

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October 1, 2003



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